PACKET RADIO REPEATER DESIGN PLAN

PRELIMINARY SPECIFICATIONS   1.10
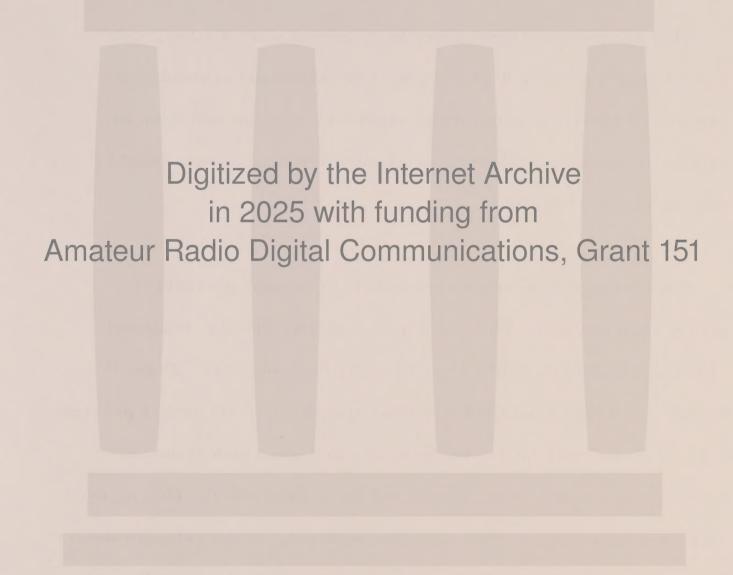
30 December 1973

I. FOREWARD

In the following document, we have tried to lay out a design plan for a packet communication network serving mobile terminals and using radio links for data transmission. Its purpose is to provide a frame of reference in which experimental prototype equipment will be introduced for testing the packet radio network concept.

This document does not describe a formal plan. Rather, it is a preliminary version which has been prepared and revised in the process of soliciting constructive feedback. It is our intention to reissue it, possibly with substantial modification, as warranted by ensuing design changes.

The design plan is one of three kinds of documents about the packet radio network. The implementation plan and the treatment of various technical issues are purposely kept separate. Thus, the design plan is not a detailed technical specification but rather presents a set of goals, objectives, performance criteria, guidelines and constraints, as well as an overall setting for the effort. The material only covers the packet communication network and not related matters such as the developments in packet radio protocols for its utilization, terminal properties, or any analysis. These subjects will be adequately covered in companion material.

Note: Any reference to this plan must identify the preliminary nature of the material and should include a reference to this document along with the release date from the cover page.

II. AN INTRODUCTION TO PACKET RADIO
GOALS & OBJECTIVES

0. History and Background   -   ARPANET, ALOHA

1. To Handle mobile terminals

        a. Into ARPANET initially
        b. For tactical communications eventuàlly
        c. Flexible and convenient access
        d. Support hand held terminals
        e. Relative speeds up to 100 mi. /hr.
        f. Interactive
        g. Up to 10mi. per repeater/ up to 2 mi. per terminal
        h. Non-urban high rise environments
        i. Broadcasting toward horizon
        j. Transparent netowrk to users

2. To Allow Specturm Sharing
        a. Shared channel access
        b. Co-existence with other systems
        c. Full protection and Security

II I. COEXISTENCE CONSIDERATIONS

a. Sensititity of other receivers in band
  cm t get too close
  may not be able to et far enough away
  radar, zadio astromony, telemetering
  low power recpetion vs. stable high power (poor receivers)
  fileter out

b. Too Hihg poewr
  unaccpetable interference in packet radio
  filter out

c. Changes in environment
  must be prepared for range of coexist requirments
  New things introduced into band
  Old things removed from band. Possibly reintroduced in
  other ways (freqs, part of PR, etc.)
  Dynamic changes - sweeps, on/off cnsiderations
  Geography considerations - points up, points out etc.

d. Combination of two techniwues to combat
  a. low level signalling to not interfere
  b. coupled with correlation detection to recover energy
  c. stay out of certain bands.
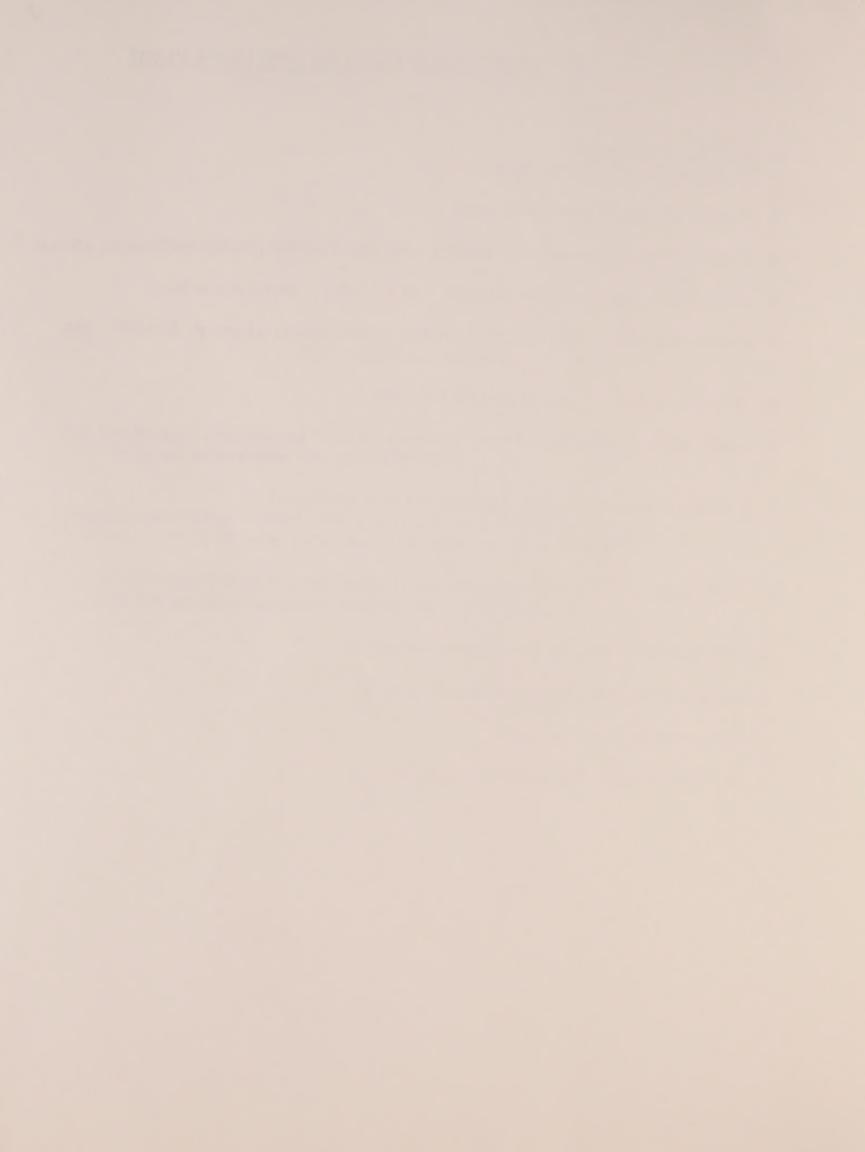
e. Leads to a channel allocation requirement
  handle in a special way
  not frequency h9pped - but can be if necessary
  low level signalling per channel

a. Structural Overview

b. Common Control by station

c. Traffic to and from station only

d. Repeater characteristics   simple, no real smarts , little buffering, cheap??

e. Delineate communication pxttion - at interfac: level if posible

f. Sample session - what happens where, initializing, closing, handoff, etc.
                              get into secutity a bit

g. Whats a packet - sma ll, adressed, etc.

h. Addressing - handled outside, labels assigned by station, names via net
                              invisible internal addressing to user

i. Fading - termials a problem? ? use two channels? ?
                 no problem for repeaters, but may have a badly located term.
               if term. location must be fixed, may have to move repeater.

j. Testing to see if terminals are there. More genereal fault detection.
                       must do this. cant rely on terminal logging out etc.

k. RF Models - ranges·of sources and sinks.

l. Sample terminal to station data patterm.

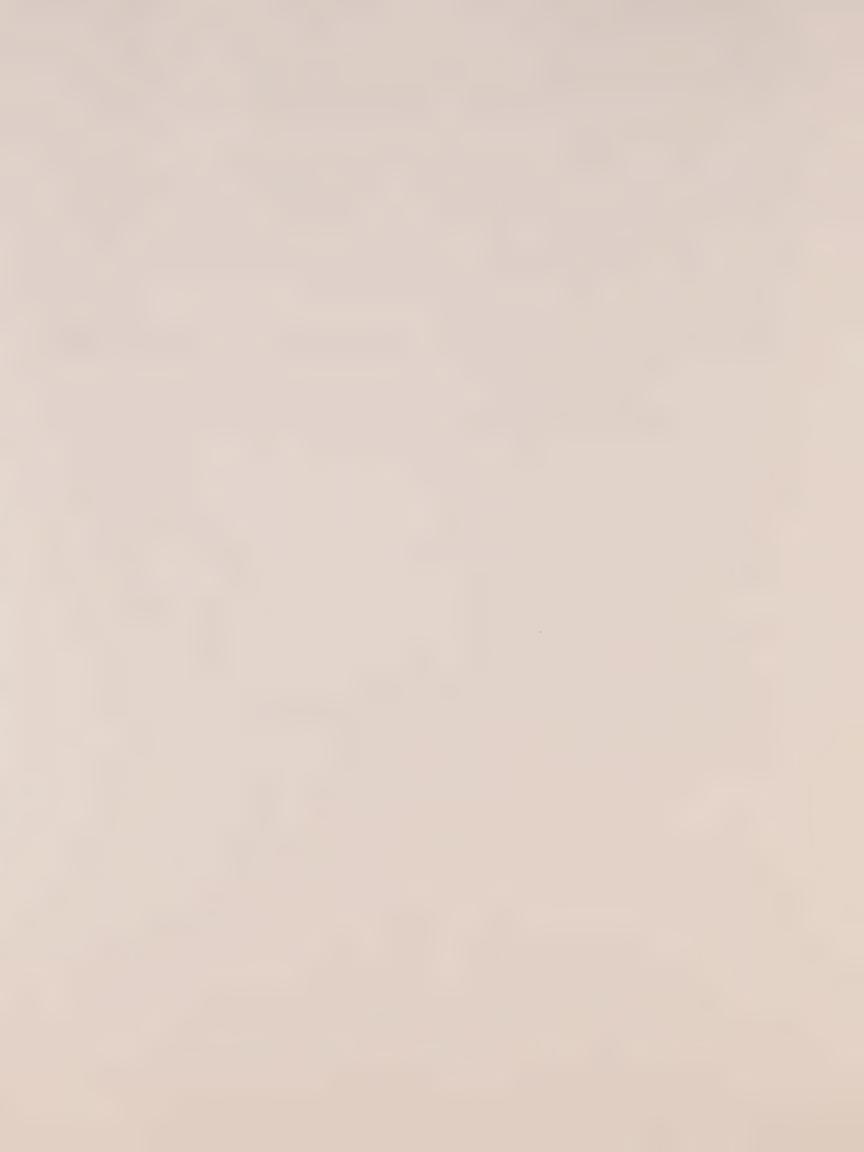m. Omni-directional antenna

n. single channel - transceiver operaton.

V. Performance Objectives and Constraints

a. DATA Rates - extermal, internal falls out of computatons

b. Delay - up to 0.1 seconds end to end   (within PR net)

c. Reliability - all considerations, mult paths, retrans, mtbf etc.

d. No. of users- or amount of traffic/mix, type etc.

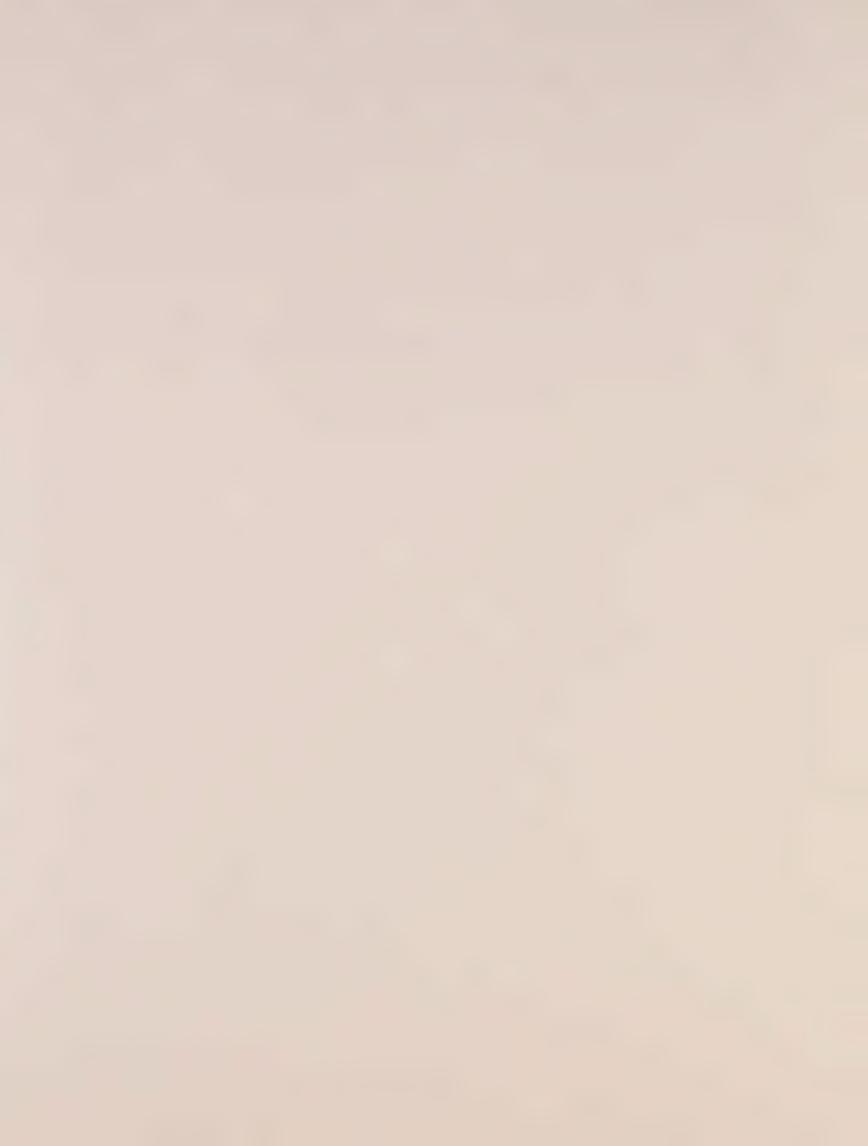e. Cpacity/Throughput 0 of one station and ajacent repeaters, system, repeater

f. Security - no spoof, no unprotected intercept, no listen etc.

g. Cost - of repeater, or sneding packet, maintencane (ops)

h. Errpr Performance - 10^{12} or better

i. Geog perf. - uniform in radio net,

j. Move around racefully - handoff easy

k. Ground speeds up to 100 mph.

l. Transparend to user

m. Topological considerations

n. Range - individual net per station, multi-stations nets

o. wt. size, power etc.

VI. Packet FORMAT

1. Data

2. Error Checking BIts

3. Address Identifier - term #, repeater

4. Sequence number - 8 bits,, 2 buffers outstanding

5. Rougint information - to station, only first time need to know repeater
                          from station. . every time

6. Size of packet - and overhead

VII. SYSTEM DESIGN

1. RF Channel Considerations

    how many channels?

    how to use them?

    terminals -one channel? two?

    signal structure

        code selelction
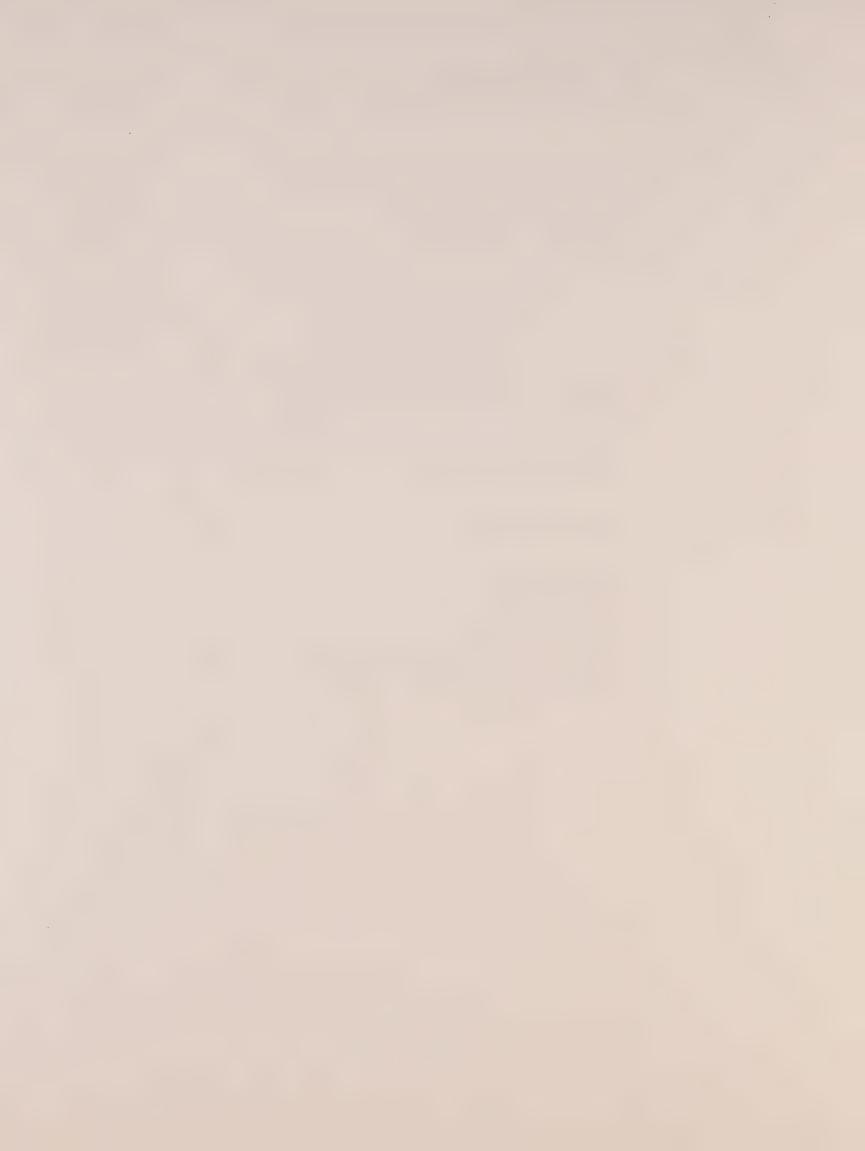
        MSK

        Preamble selection

        differential detexction

        non-coherent!!

    Diagrams (illustartive] of spread, inerference

    Reperater coverage power budgets

    Mulitple detectors close into station

    Power control - mostly in transmitter, some in rec. to comp.

    Half duplex operation

2. Network Management Strategy

    logical design

    routing

    flow control

    error control

    multi-station operation

    repeater initialization/ shutdown

    remote debugging

VIII. EQUIPMENT DESIGN

1. Interfaces

2. Power consumption

3. Programability - uproc.

4. Powering methods

5. Maintenance

6. Modularity

7. Software structure - roms, rams, etc.

8. Loading of progarmas

9. Buffer sizes and memory sizing

10. Physical description

11. summary of repeater characteristics - bw, ERP, thruput, %util, of cpu. etc.

BLOCK DIAGRAMS

    a. Antenna

    b. RF secton

    c. Logic   two kinds here - a whole block diagram

                             shwing all xom ponents. plus expand each

    d. Modem   block.

    e. COMSEC

PACKAGING INFORMATION
FORM FACTOR SKETCHES   wt size etc.
CONSTRUCTION TECHNIQUES

IX. Measurements and Testing

(to be supplied by Kleinrock and Fralick)

X. FUTURE DIRECTIONS

1. Four repeater test - 10 terminals

2. Mulit-station tests

3. Cinnection to arpaant

4. Service tests.